CLAIMS

What is claimed is:

1. A motor, comprising:

a stator containing a first winding and a second winding driven by alternating currents;

a rotor arranged to rotate relative to the stator, the rotor containing a third winding and a fourth winding, the third and fourth windings of the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating currents in the first and second windings of the stator; and

a circuit in communication with the third and fourth windings for controlling the phase angle of the rotor generated magnetic field and generating a rotating magnetic field that is in phase-lock with the alternating currents in the first and second windings of the stator.

2. The motor of claim 1, wherein the third and fourth windings are disposed at a ninety-degree phase shift relative to each other.

3. The motor of claim 2, wherein the circuit sequences a current through each of the third and fourth windings of the rotor for generating the rotating magnetic field.

4. The motor of claim 1, further comprising a second circuit in communication with the third and fourth windings of the rotor for controlling the magnitude of the rotor generated magnetic field.

5. The motor of claim 1, further comprising a feedback control device in communication with the first and second windings of the stator and the third and fourth windings of the rotor for determining parameters associated with controlling the phase of the rotating magnetic field.

6. The motor of claim 5, wherein the parameters associated with controlling the phase of the rotating magnetic field are selected from the group consisting of a phase angle of the alternating currents in the first and second windings of the stator, an angular position of the rotor and an instantaneous angular velocity of the rotor.

7. The motor of claim 6, wherein the feedback control device comprises a portion for determining the phase angle of the alternating currents in the first and second windings of the stator and an angular position feedback device for determining the angular position of the rotor and the instantaneous angular velocity of the rotor.

8. The motor of claim 7, wherein the position feedback device is selected from the group consisting of an optical encoder and a magnetically coupled resolver.

9. The motor of claim 1, wherein the first and second windings of the stator are disposed at a ninety-degree phase shift relative to each other.

10. The motor of claim 1, further comprising a switch in communication with at least one of the third and fourth windings of the rotor for switching off the rotor at a predetermined rotor speed.

11. The motor of claim 1, wherein the circuit is directly connectable to the rotor.

12. The motor of claim 10, wherein the circuit further comprises means for transferring power for operating the circuit from a stationary portion of the motor to the rotor.

13. The motor of claim 11, wherein the means for transferring the power is selected from the group consisting of brushes, wheels on a track, non-contact power transmission devices, radio waves and rotary transformers.

14. The motor according to claim 10, further comprising a generator connected to the rotor for generating power for operating the circuit.

15. The motor of claim 1, wherein the circuit is remotely connectable to the rotor.

16. The motor of claim 15, wherein the circuit further comprises means for transferring control signals for controlling the phase angle of the rotor generated magnetic field from a stationary portion of the motor to the rotor.

17. The motor of claim 16, wherein the means for transferring the control signals is selected from the group consisting of brushes, wheels on a track, non-contact signal transmission devices, radio waves and rotary transformers.

18. The motor of claim 1, further comprising a rectifier disposed on the rotor for rectifying currents induced in the third and fourth windings of the rotor by magnetic flux generated by a powered stator.

19. The motor of claim 1, wherein the circuit includes a microprocessor.

20. The motor of claim 1, wherein the first and second windings of the stator are continuously driven.

21. The motor of claim 1, further comprising a start circuit in communication with the first and second windings of the stator and the third and fourth windings of the rotor for driving the first winding of the stator at the first phase.

22. The motor of claim 21, wherein the start circuit includes a rectifier and a transistor bridge, the rectifier having an input portion for connecting to a source of alternating current and an output portion in communication with the transistor bridge for supplying direct current power to the transistor bridge, the transistor bridge for driving the second winding of the stator at a second phase by switching rectified direct current power from the rectifier into one end of the second winding of the stator.

23. The motor of claim 22, wherein the transistor bridge is selected from the group consisting of an H bridge and a half-bridge.

24. The motor of claim 21, wherein the transistor bridge is disposed between the rectifier and one of the third and fourth windings of the rotor.

25. The motor of claim 21, further comprising a one phase circuit connectable at an input portion to a source of first alternating current and an output portion in communication with one of the first and second windings of the stator.

26. The motor of claim 25, wherein the one phase circuit provides functions selected from the group consisting of current limiting, thermal limiting and soft starting.

27. The motor of claim 21, wherein the starter circuit further comprises a thermal switch having an input portion connectable to a source of alternating current and an output portion in communication with one of the first and second windings of the stator.

28. The motor of claim 21, wherein the starter circuit further comprises a phase shifting capacitor connected in series with a centrifugal switch, the phase shifting capacitor and the centrifugal switch connectable between a source of alternating current and one of the third and fourth windings of the rotor.

29. The motor of claim 1, wherein the rotor is formed using a permanent magnetic material and a control winding.

30. A motor, comprising:

a stator containing a winding driven by an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a winding, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current in the stator;

a control transformer containing a primary winding and a secondary winding, the control transformer primary winding connected to the stator and the control transformer secondary winding in communication with the rotor winding;

a control circuit in communication with the control transformer primary winding, the control circuit in communication with the rotor winding for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current in the stator; and

an angular position feedback device in communication with the control circuit for providing an instantaneous angular position of the rotor and an instantaneous angular velocity of the rotor to the control circuit.

31. The motor of claim 30, further comprising a start circuit disposed between the stator winding and the rotor winding, the start circuit in communication with the control circuit.

32. The motor of claim 31, further comprising a one-phase circuit in communication with the stator.

33. The motor of claim 31, further comprising a rectifier for rectifying power delivered by a source of alternating current, the rectifier in communication with a drive circuit for driving the rotor winding, the drive circuit in communication with the control circuit.

34. The motor of claim 31, further comprising a thermal switch in communication with the stator winding for disconnecting a source of alternating current from the stator.

35. The motor of claim 31, further comprising a centrifugal switch in communication with the stator winding for disconnecting a source of alternating current from the stator winding.

36. The motor of claim 35, further comprising a phase-shift capacitor connected in series with the centrifugal switch.

37. The motor of claim 30, further comprising a drive circuit disposed between the control circuit and the control transformer primary.

38. The motor of claim 30, further comprising a rectifier disposed between the rotor wing and the control transformer secondary winding.

39. The motor of claim 30, wherein the control transformer is a rotary transformer.

40. The motor of claim 30, further comprising a power generator connected to the rotor shaft for supplying power to the control circuit.

41. A motor, comprising:

a stator containing a plurality of windings driven by an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a plurality of windings, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current in the stator;

a plurality of control transformers each containing a primary winding and a secondary winding, the plurality of control transformers each containing the primary winding connected to the stator, the plurality of control transformers each containing the secondary winding in communication with the plurality of rotor windings;

a control circuit in communication with the plurality of control transformers primary windings, the control circuit in communication with the plurality of rotor windings for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current; and

an angular position feedback device in communication with the control circuit for providing the instantaneous angular position of the rotor and the instantaneous angular velocity of the rotor to the control circuit.

42. The motor of claim 41, wherein the plurality of control transformers is a plurality of rotary transformers.

43. The motor of claim 41, further comprising a power generator connected to the rotor for supplying power to the control circuit.

44. A motor, comprising:

a stator containing a main winding and a capacitor phase-shifted winding, each of the main winding and the capacitor phase-shifted winding are driven by an alternating current; and

a rotor arranged to rotate relative to the stator.

45. The motor of claim 44, wherein the rotor further comprises a plurality of windings and the stator further comprises a plurality of windings.

46. The motor of claim 45, wherein at least one of the plurality of the rotor windings is driven by an alternating current and at least one of the plurality of rotor windings is driven by an electronic control circuit.

47. The motor of claim 45, wherein at least one of the plurality of the stator windings is driven by an alternating current and at least one of the plurality of stator windings is driven by an electronic control circuit.

48. The motor of claim 45, wherein at least two of the plurality of the rotor windings are driven by multiple phases of an alternating current power source.

49. The motor of claim 45, wherein at least two of the plurality of the stator windings are driven by multiple phases of an alternating current power source.

50. The motor of claim 45, wherein at least two of the plurality of the rotor windings is driven by a combination of alternating current power and an electronic control circuit.

51. The motor of claim 45, wherein at least two of the plurality of the stator windings is driven by a combination of alternating current power and an electronic control circuit.

52. A motor, comprising:

a stator containing a first winding and a second winding driven by an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a third winding and a fourth winding, the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

means for controlling the phase angle of the generated magnetic field in communication with the means for transferring signals, the means for controlling in communication with the rotor winding; and

means for generating a rotating magnetic field that is in phase-lock with the alternating current in communication with the means for transferring signals, the means for controlling in communication with the rotor winding.

53. A motor, comprising:

a stator containing a winding driven by an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing one or more windings, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

means for transferring signals from a stationary portion of the motor to a rotating portion connected to the rotor, the means for transferring signals containing a primary winding and a secondary winding, the means for transferring signals in communication with the rotor winding;

means for controlling the phase angle of the generated magnetic field in communication with the control transformer primary winding, the means for controlling the phase angle of the generated magnetic field in communication with each of the rotor windings and the means for transferring signals to and from the rotor windings; and

means for generating a rotating magnetic field that is in phase-lock with the alternating current in communication with the means for transferring signals.

54. A motor, comprising:

a stator containing a plurality of windings driven by an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a plurality of windings, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

a plurality of means for transferring signals from a stationary portion of the motor to a rotating portion connected to the rotor shaft, the plurality of means for transferring signals containing a primary winding and a secondary winding, the plurality of means for transferring signals each containing a secondary winding in communication with the plurality of rotor windings;

means for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current, the means for controlling the phase angle in communication with each of the plurality of control transformers primary windings and the plurality of rotor windings; and

means for providing an instantaneous angular position of the rotor and an instantaneous angular velocity of the rotor to the means for controlling the phase angle.

55. A motor, comprising:

a stator containing a main winding;

means for phase-shifting the main winding and the means for phase-shifting driven by an alternating current; and

a rotor arranged to rotate relative to the stator.

56. A generator, comprising

a stator containing a first winding and a second winding, at least one of the first and second windings for generating an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a third winding and a fourth winding, the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current; and

a circuit in communication with the third and fourth windings for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current.

57. A generator, comprising:

a stator containing a winding for generating an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a winding, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

a control transformer connected to the rotor, the control transformer containing a primary winding and a secondary winding, the control transformer secondary winding in communication with the rotor winding;

a control circuit in communication with the control transformer primary winding, the circuit in communication with the rotor winding for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current; and

an angular position feedback device in communication with the control circuit for providing the instantaneous angular position of the rotor and the instantaneous angular velocity of the rotor to the control circuit.

58. A generator, comprising:

a stator containing two or more windings for generating an alternating current;

a rotor containing a winding arranged to rotate relative to the stator;

a circuit in communication with the rotor winding for controlling the phase angle of the generated magnetic field and for generating a rotating magnetic field that is in phase-lock with the alternating current generated by the stator.

59. The generator of claim 58, further comprising:

a control transformer connected to the rotor, the control transformer containing a primary winding and a secondary winding, the control transformer secondary winding in communication with the rotor winding;

a control circuit in communication with the control transformer primary winding, the circuit in communication with the rotor winding for controlling the phase angle of the generated magnetic field and generating a rotating magnetic field that is in phase-lock with the alternating current; and

an angular position feedback device in communication with the control circuit for providing the instantaneous angular position of the rotor and the instantaneous angular velocity of the rotor to the control circuit.

60. The generator of claim 59, wherein the generator generates alternating current power at a constant frequency irrespective of variations in input shaft speed.

61. A generator, comprising

a stator containing a first winding and a second winding, at least one of the first and second windings for generating an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a third winding and a fourth winding, the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

means for controlling the phase angle of the generated magnetic field in communication with each of the means for transferring signals and the rotor winding; and

means for generating a rotating magnetic field that is in phase-lock with the alternating current in communication with the means for transferring signals.

62. A generator, comprising:

a stator containing a winding for generating an alternating current;

a rotor arranged to rotate relative to the stator, the rotor containing a winding, and the rotor generating a magnetic field having an amplitude and a phase angle relative to the alternating current;

means for transferring signals from a stationary portion of the motor to a rotating portion connected to the rotor, the means for transferring signals containing a primary winding and a secondary winding, the means for transferring in communication with the rotor winding;

means for controlling the phase angle of the generated magnetic field in communication with each of the means for transferring signals and the rotor winding;

means for generating a rotating magnetic field that is in phase-lock with the alternating current in communication with the means for transferring signals; and

means for providing an instantaneous angular position of the rotor and an instantaneous angular velocity of the rotor to the means for controlling the phase angle.

63. A generator, comprising:

a stator containing two or more windings for generating alternating current power;

a rotor containing a winding arranged to rotate relative to the stator;

means for controlling the phase angle of the generated magnetic field in communication with the rotor winding; and

means for generating a rotating magnetic field that is in phase-lock with the alternating current generated by the stator in communication with the rotor winding.

64. A rotor arranged to rotate relative to a stator, the stator containing a first winding driven by an alternating current, the rotor comprising:

a second winding for generating a magnetic field having an amplitude and a phase angle relative to the alternating current; and

a circuit in communication with the second winding for supplying power to the second winding and for generating a rotating magnetic field.

65. The rotor of claim 64, further comprising a magnetic material disposed on the rotor, wherein the magnetic material in conjunction with the second winding generates the rotating magnetic field.

66. The rotor of claim 65, wherein the magnetic material is a permanent magnet.

67. The rotor of claim 64, further comprising means for transferring power for operating the circuit from a stationary portion of the motor to the rotor.

68. The rotor of claim 67, wherein the means for transferring the power is selected from the group consisting of brushes, wheels on a track, non-contact power transmission devices, radio waves and rotary transformers.

69. The rotor of claim 64, further comprising a generator connected to the rotor for generating power for operating the circuit.

70. The rotor of claim 64, wherein the circuit further comprises means for transferring control signals for controlling the phase angle of the generated magnetic field from a stationary portion of the motor to the rotor.

71. The rotor of claim 70, wherein the means for transferring the control signals is selected from the group consisting of brushes, wheels on a track, non-contact signal transmission devices, radio waves and rotary transformers.

72. The rotor of claim 64, further comprising a control device disposed on the rotor for generating a rotating magnetic field.

73. The rotor of claim 72, further comprising a power generation device disposed on the rotor.

74. A rotor arranged to rotate relative to a stator, the stator containing a first winding driven by an alternating current, the rotor comprising:

a second winding;

means for generating a magnetic field having an amplitude and a phase angle relative to the alternating current; and

means for supplying power to the second winding in communication with the means for generating the magnetic field .

75. A control circuit for measuring a phase of a stator containing a stator winding and an angular position of a rotor and velocity of the rotor, the rotor containing a rotor winding, the rotor rotating relative to the stator and the rotor winding generating a flux vector, the control circuit for driving the rotor flux vector such that the rotor flux vector remains in a locked phase relationship with an alternating current phase of the stator, the control circuit comprising:

an angular position feedback device for measuring an angular velocity and position of the rotor; and

a comparator in communication with the angular position feedback device for comparing an instantaneous rotor speed and a desired rotor speed and varying the magnitude of the rotor winding generated flux vector for minimizing the difference between the instantaneous rotor speed and the desired rotor speed .

76. The control circuit of claim 75, further comprising a portion connectable with the rotor winding for applying a first magnetic pulse of sufficient magnitude to magnetize an existing magnetic material disposed on the rotor such that the magnetic material continues to supply flux after the magnetic pulse has dissipated.

77. The control circuit of claim 76, further comprising a portion connectable with the rotor for applying a second magnetic pulse sufficient to demagnetize the magnetic material disposed on the rotor such that the magnetic material supplies less flux after the magnetic pulse has dissipated.

78. A control circuit for measuring a phase of a stator containing a stator winding and an angular position and velocity of a rotor containing a rotor winding, the rotor rotating relative to the stator and the rotor winding generating a flux vector, the control circuit driving the rotor flux vector such that the rotor flux vector remains in a locked phase relationship with an alternating current phase of the stator, the control circuit comprising:

means for measuring an angular velocity and position of the rotor; and

means for comparing an instantaneous rotor speed and a desired rotor speed in communication with the means for measuring angular velocity and position;

means for varying the magnitude of the rotor winding generated flux vector; and

means for minimizing the difference between the instantaneous rotor speed and the desired rotor speed .

79. A method of controlling a motor including a rotor containing a rotor winding and a stator containing a stator winding, comprising:

simultaneously controlling a stator and a rotor arranged to rotate relative to the stator;

measuring a torque ripple generated by the motor; and

correcting the torque ripple.

80. The method of claim 79, further comprising controlling the acceleration and deceleration of the rotor based on outside or programmed-in constraints.

81. The method of claim 79, further comprising varying the speed of the motor.

82. The method of claim 79, further comprising controlling the motor to act either as a generator or a motor on demand.

83. A method of controlling a rotor, comprising:

determining an angular position of a rotor;

determining a rotor flux vector amplitude;

separating the rotor flux vector into two separate components; and

driving each separate rotor flux vector component in accordance with a total rotor flux vector magnitude.

84. The method of claim 83, further comprising:

measuring the angular velocity of the rotor;

determining the instantaneous motor velocity;

determining a command motor velocity; and

comparing the instantaneous motor velocity and the command motor velocity.

85. The method according to claim 83, further comprising:

determining a phase angle of an incoming alternating current signal;

comparing the position of the rotor with the incoming phase angle of the alternating current signal; and

providing the difference between the position of the rotor with the incoming phase angle of the alternating current signal to a rotor flux vector component separator.

86. A method of transferring signals to a rotor, comprising:

generating a signal to be transferred to the rotor;

encoding the signal to an analog waveform;

transferring the analog waveforms to a primary portion of a rotary transformer; and

transferring the analog waveforms across an air gap from the primary portion of the rotary transformer to a secondary portion of the rotary transformer.

87. The method of claim 86, further comprising:

decoding the analog waveforms on the secondary side of the rotary transformer.

88. A method of controlling a rotating magnetic flux vector generated in a stator containing a winding by a rotor containing a winding, comprising:

determining a phase angle of the rotor;

determining a phase angle of an alternating current source supplying power to the stator winding;

comparing the phase angle of the rotor and the phase angle of the alternating current source; and

controlling the phase angle of the generated magnetic field and generating a rotating magnetic field that is in phase-lock with the alternating current in accordance with the difference between the phase angle of the rotor and the phase angle of the alternating current source.

89. The method of claim 88, further comprising, in a rotor containing a plurality of windings, sequencing a current through each of the plurality of windings for generating the rotating magnetic field.

90. The method of claim 88, further comprising controlling the magnitude of the generated magnetic field.

91. The method of claim 88, further comprising determining parameters associated with controlling the phase of the rotating magnetic field.

92. The method of claim 88, further comprising switching off the rotor at a predetermined rotor speed.

93. The method of claim 88, further comprising transferring power for operating a control circuit disposed on the rotor from a stationary portion of the motor to the rotor.

94. The method of claim 88, further comprising generating power at the rotor side of the motor for operating a control circuit disposed on the rotor.

95. The method of claim 88, further comprising transferring control signals for controlling the phase angle of the generated magnetic field from a stationary portion of the motor to the rotor.

96. The method of claim 88, further comprising rectifying currents induced in the rotor winding by the magnetic flux generated by a powered stator.

97. The method of claim 88, further comprising continuously driving the stator winding.

98. The method of claim 88, further comprising providing a permanent magnet material on the rotor.